same time it is vastly different from the great depth given to the lake by old travellers, whose mistake has been perpetuated.

In his anniversary address to the Geographical Society last week Lord Aberdare paid a just tribute to the services rendered to geography in the region west of Lake Nyassa by Mr. F. C. Selous, who has hitherto been best known as a mighty hunter of large game. This gentleman, we learn, in 1878 penetrated for 150 miles the unknown country north of the Zambesi, in the direction of Lake Bangweolo. He has since crossed in various directions the Matabele country south of the Zambesi, discovering two new rivers and defining the courses of others which had previously been laid down from vague information. His notes on the River Chobe have already been published by the Geographical Society. We understand that the fine trophies of the chase which Mr. Selous brought back from South Central Africa have been placed in the hands of Messrs. Rowland Ward and Co. for preparation.

FROM the report of the progress of the Ordnance Survey which has just been issued, accompanied by useful diagrams, we learn that it is expected that the whole survey will be completed by 1890, as the staff is to be augmented in consequence of increased funds being placed at the disposal of the Director-General.

The programme of the first German "Geographentag" at Berlin, on June 7 and 8, contains the following addresses:—Prof. Zöppritz (Königsberg), on the condition of the earth's interior; Prof. Neumayer (Hamburg), on the importance of magnetic researches from a geographical point of view; Prof. Rein (Marburg), on the Bermuda Islands and their coral reefs; Prof. Bastian (Berlin), on the problems of ethnology; Prof. Kirchhoff (Halle), on the methods of teaching geography in schools. Professors Wagner, Meitzen, and Ascherson will speak on similar subjects.

Dr. Crevaux has completed his third South American journey. He descended the Guayabero River (a tributary of the Orinocco) on rafts, and made an exact survey of this river. The survey comprises 1275 miles, of which 375 are a complete desert. By the assistance of natives Dr. Crevaux and his companions reached Ciudad-Bolivar, whence they embarked for Trinidad on board a steamer. Shortly before the end of the journey one of the travellers, a sailor of the name of Burban, was killed by a sting-ray (Trygon pastinaca). Later on Dr. Crevaux visited the villages of natives in the Orinocco delta, collecting interesting anthropological data.

The Central Union for Commercial Geography at Berlin intends to erect a Commercial Geographical Museum in that city. The preliminaries are so far completed that a hall for exhibiting the objects has been hired, a provisional committee formed, and the bye-laws printed. The Union is rapidly extending its branches all over Germany. Among the latest foundations are those at Cassel, Marburg, Hanau, Frankfurt, and Wiesbaden, i.e. no less than five in the province of Hessen-Nassau.

AT the May meeting of the Berlin Geographical Society the latest news of the German explorers in Africa were communicated to the members. A letter from Dr. Rohlfs was dated from Gondar. The traveller knew nothing of the death of the King of Abyssinia. The disposition of the king for the further journey of Dr. Stecker was very favourable, and the latter was to leave at once for Shoa-land with a guide. Dr. Pogge and Lieut. Wissmann had arrived at Malange on January 25. Here they intended to stay a while before leaving for the interior. Dr. Buchner arrived at Malange on March 8 on his return journey, and met Major von Mecho. Buchner's misfortune of being obliged to turn back after three unsuccessful attempts to penetrate further is already known to our readers. From Madagascar a letter was received from Dr. Hildebrandt. He left Tananarivo on February 17, and travelled southwards with great hopes of a speedy success.

A LETTER from Dr. Junker to the Austrian Consul at Chartum dispels all the rumours afloat regarding his supposed assassination. He only returned to his station in December last from the journey he had taken. He first crossed the Welle River and travelled in a westerly direction to the Mangbattu tribe. Then he proceeded to some Government stations in Eastern Mangbattu land, getting a little beyond Munsa's former residence, in the vicinity of which is Miam's tomb (not in the Niam Niam land, as indicated by the Italian map). The traveller crossed the Gadde and Bibali rivers at their confluence, and then returned to his station.

THE new number of *Le Globe* opens with a continuation of M. de Morsier's papers on the plains and deserts of the two continents, and also contains a sketch of the geographical work of last year by M. Bouthillier de Beaumont, as well as notices of the Arctic campaign of 1880 and the *Feannette* expedition.

Some long letters have recently been received from Père Livinhac, the head of the Algerian Missionary Expedition in Uganda. In referring to the organisation of the country he says that under the Kabaka, or absolute monarch, are the chiefs of the great families, called Mohamis, of whom three specimens came to England last year with Messrs. Wilson and Felkin. After these come chiefs of inferior rank, who own allegiance to the Kabaka through the Mohamis. Last of all is the class of slaves or Wada. Mesa, Père Livinhac says, is regarded by his subjects as a species of divinity, and they attach a supernatural virtue to objects which he has touched. He however appears to be very much under the influence of a clique of Mohamis, who threaten to dethrone him if he encourages foreigners.

THE Queensland Government have lately issued a large scale map of part of the Colony, on which is laid down the proposed route of the transcontinental railway to Point Parker, on the Gulf of Carpentaria. This, we observe, crosses the lower course of the Gregory, where, according to a recent official report, that river overflows and covers most of the plains for a considerable distance on either bank. It is difficult to reconcile this uncomfortable fact with the report of Mr. Watson's expedition, to which we lately referred, that high ground ran right down to Point Parker. If this be really the case, the surveying expedition must have followed a different course to the westward of that laid down for it, possibly crossing the Gregory at a much higher point in a comparatively unknown part of the country.

WE regret to learn that Père Law, whose unfortunate expedition from Gubuluwayo to Umzila's country was referred to in NATURE of May 5, died of fever and general exhaustion at that chief's kraal last November. During his comparatively short stay in Africa he had rendered conspicuous service to geography by the determination of numerous heights and positions.

A VERY interesting experiment is to be tried in West Central Africa by the members of the Livingstone (Congo) Inland Mission. We understand that seeds of the different species of Chinchona, which have been obtained from the Government plantations in India, are to be sent out to them with a view to ascertaining whether it could be successfully cultivated in the mountain valleys of the Congo.

It is probable that the successor of Admiral La Ronciere le Noury, late President of the French Geographical Society, will be M. Ferdinand de Lesseps.

## SOLAR PHYSICS—SUN-SPOTS 1

To the student of science who contemplates the sun by day or the stars by night two questions will inevitably occur. The first will have reference to the source from which those vast orbs have derived their stupendous store of high-class energy; the second to the astonishing regularity with which they are able to give it out. It is not impossible to measure in a rough way the amount of heat which our own sun must have possessed. For in the first place we are forced to allow that our luminary must have shone as it does now for millions of years. In the next place the amount of solar heat received by the earth in one year will about liquefy a layer of ice 100 feet thick covering the whole surface of the earth; and lastly, the sun gives out 2,300,000,000 times as much heat as the earth receives.

These considerations viewed together will perhaps enable us to form a faint conception of the amount of light and heat which our luminary must have given out during its prolonged existence. And yet the sun is by no means one of the most powerful stars, being only about the average in brightness.

We ask then, in the first place, from what source has this inconceivably vast store of energy been derived? If science be not able with absolute certainty to reply to this question, it is yet able to indicate the most probable origin of the supply.

The only hypothesis yet thought of that can account for it is that which first occurred to Mayer and Waterston, and which has been worked out by Helmholtz and Thomson in such a way

 $<sup>^{\</sup>rm T}$  Lecture in the Course on Solar Physics at South Kensington ; delivered by Prof. Balfour Stewart, F.R.S., April 27.

as almost to prove that there is no other known power capable of producing such a stupendous result.

According to this hypothesis we may imagine the particles of matter, when originally produced, to have been at a great distance from each other, all however being endowed with the power of gravitation—forming in fact a chaotic mass. As these particles gradually came together in virtue of their mutual attraction, heat would be generated in the condensing mass, and it has been calculated that this cause, by storing up a vast amount of heat in the sun, is sufficient to account for its wonderful outpouring of heat and light throughout a long series of ages.

But the whole of the riddle is not thus solved. A man may have vast resources and yet a total absence of ready money. a nation may have plenty of food and yet not be able to bring it fast enough into a famine-stricken district. And so the sun may possess in its interior abundance of high-class energy and yet be unable to bring it quickly to the surface—indeed it has been calculated by Sir William Thomson that if the sun were an incandescent solid body its surface would probably cool in a few minutes of time. The perplexing fact about the sun and stars is not so much that they have somehow obtained a vast store of energy, as that they are able to bring it to the surface with an astonishing regularity. Nevertheless this regularity, great as it is, is not apparently perfect. There are a good many examples of variable stars of which some few suffer sudden and extreme changes of brilliancy, while in others the variation is much less conspicuous. In these orbs the transport service by which the heat is brought to the surface appears to work unequally, and even in some cases to break down altogether. Were we much even in some cases to break down altogether. nearer to them than we are we might study these inequalities with advantage, and perhaps gain some insight thereby into the nature of the wonderful machinery that brings the heat to the surface.

As it is however we must chiefly confine curselves to a study of the sun. Can we therefore hope to find out the nature of the machinery by which the light and heat of our sun are brought to the surface? and is this machinery unequal in its action? Is the sun, in fine, a variable star? First of all, let us have a clear conception of the precise meaning of this question. No doubt the clouds by day and the earth itself by night interpose themselves between us and our luminary so as to render its direct influence exceedingly variable; but this is not the point. quently in passing along the streets of an evening we see into the interior of some room which has just been lighted up; but immediately the blind is pulled down, and we see it no longer. The gas may however be all the while burning behind the blind with a constant lustre; or it may be that from water in the pipe or some other cause the flame is intermittent. Now this is the point which we wish to determine about our sun. Is sunlight intrinsically constant, or is it subject to variations? and if so, can we determine the extent and the periods of these variations? Now at first sight it seems exceedingly strange that we are compelled to ask this question.

It might naturally be imagined that astronomers, who can give us the hight variations of Beta Lyræ or some other variable star with the greatest precision, must certainly be able to give us similar information about the sun. That they are totally unable to do so is unquestionably very strange. When however we begin to examine we find several reasons for this curious failure. In the first place we must all be glad to think that within historic times at least the variations of the sun's lightgiving power can never have amounted to a large proportion of the whole. Had this been otherwise none of us could have been alive at this moment to speculate on solar variability.

Nevertheless these suspected differences, although not exceedingly great, may still be large enough to enable astronomers in some remote part of the universe to pronounce our sun to be a variable star. How is it then that we who are mainly concerned in this variability are yet unable at first sight to decide upon the fundamental question of its existence?

We have not far to seek for an answer to this enigma. The fact is we are too near and too deeply concerned in the issues to be able easily to detect the variation. We have never the opportunity of comparing the sun's light with the pure light of the stars in the way in which we can compare the light of one star with that of another. We must therefore resort to means by which the direct light and heat of the sun may be accurately measured. Now it cannot be said that instruments for this purpose do not exist, but they have not been systematically made use of to determine this important point, and indeed there almost appears

to be a reluctance in humanity to face the fact of the sun's variability.

When, in process of time, the telescope came to be invented, by its means Fabricius and Galileo speedily discovered that the face of our luminary was not altogether free from spots. fact had been previously known to the Chinese, who in the course of their long and peculiar civilisation had recorded many instances where such spots were large enough to be visible to the naked eye. But at present we have to do with the progress of European thought. The first accurate observer of these phenomena was Hofrath Schwabe of Dessau, a distinguished German astronomer. More than fifty years ago he set himself to the task of taking frequent sketches of the disk of the sun, which might record approximately the positions and areas of the various groups of spots. For forty years he continued to labour at this somewhat monotonous task with great perseverance, until at length his unwearied labours were crowned by a singular and unlooked-for discovery. This consisted in the evident periodicity of these phenomena. During some years Schwabe found the sun to be almost entirely free from spots, while on other occasions the solar disk was mottled over with very frequent groups, the period from maximum to maximum, or from minimum to minimum, being nearly eleven years. From the observations of Schwabe and others it would appear that 1828, 1837, 1848, 1860, and 1870 were years of maximumspot frequency, while 1833, 1843, 1856, 1867, and 1877 were characterised by a nearly total absence of spots. Carrington, of this country, followed in the steps of Schwabe, and gave the world a very accurate record of the spots which appeared from 1854 to 1860 inclusive.

In 1858 De La Rue introduced the application of photography to solar research, and since then photoheliographs have been at work at Kew, Ely, and Greenwich, in this country, at Wilna and Moscow in Russia, at Mauritius, Melbourne, India, and Cambridge, U.S., more or less continuously up to the present time.

I can only allude to the magnificent solar pictures produced by Langley at the Alleghany Observatory, and more recently by M. Janssen, the distinguished French astronomer, as forming a new point of departure in the history of solar delineation. Janssen's pictures are more than a foot in diameter, and in them every minute detail of the sun's structure is accurately repre-

But it is time to tell you what a sun-spot really is. Prof. Wilson of Glasgow made in 1774 an observation which greatly startled the scientific world. He found that sun-spots behaved exactly as if they were caverns with sloping sides dug into the body of the sun. The bottom of these caverns is generally black, while the sloping sides are less so. The black portion is therefore called the umbra, while the less black sloping sides are called the penumbra of the spot. It is easy to explain the nature of Wilson's reasoning. The sun, it is well known, revolves on its axis about once in twenty-six days from east to west, so that a spot will take about thirteen days to travel across the visible disk or hemisphere. It will come on at the left-hand border or limb and disappear at the right, provided it remains so long. Now Wilson noticed that when a spot is near the limb the penumbra on the side nearest the sun's visual centre is hidden from our view, on the same principle by which, when looking into a silver jug, for instance, from one side of it, that interior which is nearest the eye is hidden from the view. In fine, he concluded, with perfect justice, that spots were pits or hollows with sloping sides, and we are justified in adding that they are cloud pits, and not caverns of solid matter.

These conclusions of Wilson have been abundantly confirmed by the Kew observers, Mr. De La Rue and his colleagues, and also by the spectroscopists who have devoted themselves to the

It has furthermore been shown by these observers why the bottoms and sides, but more especially the bottoms, of such caverns should be blacker than the sun's ordinary surface. They are blacker because they are colder, and they are colder because they represent a down-rush of matter from the high and comparatively cold regions of the solar atmosphere—of some kind of celestial hail, we may perhaps imagine. So magnificent is the scale of operations that fifty or sixty of our own earths might be dropped into the cloud-cavern formed by the down-rush—at least in the case of large spots.

But a down-rush implies an up-rush, and we may add that a down-rush of matter comparatively cold implies an up-rush of

matter comparatively hot. We have abundant evidence of the existence of such up-rushes in the sun. Astronomers have been long familiar with the existence of two solar phenomena which occur together—spots and facula. Just as a spot represents something which is blacker, and therefore colder, than the ordinary solar surface, so a facula (torch) represents something which is brighter, and therefore hotter, than the surrounding regions. As I have said, faculæ and sun-spots accompany each other, and we have evidence from various quarters that the former are not merely high up in the solar atmosphere, but that they frequently represent matter in the very act of ascending, just as a sun-spot frequently represents matter in the very act of falling down.

If we turn now to those regions of the sun's disk in which there are no spots we do not find a uniformly luminous appearance. We find rather a fine mottled or granular surface consisting of certain bright patches and of others comparatively dark. The black patches may perhaps be regarded as very minute sunspots, and the bright patches as faculæ on a small scale. Probably, too, the bright are up rushes of comparatively hot, and the dark down-rushes of comparatively cold matter.

Thus we may imagine that the difference between a spotted and an unspotted portion of the solar surface does not consist so much in a difference in the kind of things there present as in their size. In the unspotted portion we have down-rushes and up-rushes side by side but on a small scale, while in the spotted region we have also down-rushes and up-rushes, but on a large scale.

It thus appears that a prominent characteristic of the solar surface is the presence side by side of gigantic up- and downcurrents, the up-rushes consisting of very hot and very bright matter carried upwards from the heart of the sun, while the down-rushes consist of comparatively cold matter carried downwards from above.

We may add that this system of currents appears to be in all respects most powerful during periods of maximum sun-spots, at which times the velocities of solar matter are absolutely enormous. By a spectroscopic method we can estimate these velocities, and we find that on some occasions they reach the almost incredible speed of 150 miles per second.

As yet, however, we have only added another to the puzzles of solar physics. We began by expressing our astonishment at the power which the sun possesses of continuously pouring out vast quantities of heat and light, and we must now add to this our astonishment at the almost incredible velocity of its surface currents. We are thus presented with a couple of wonders instead of one; but is it not possible that the one of these may explain the other?

May not these gigantic currents denote the very machinery we are in search of, and in virtue of which the sun becomes able to carry light and heat from the interior to the surface, so as to give us a continuous and powerful supply?

The sagacity of the late Sir John Herschel was not behind in detecting the true state of the case. He suggested the probability that at times of maximum sun-spots the sun-pot, as he expressed it, may be in reality boiling very fiercely, and may therefore be giving us more of what we all want instead of less -be in fact preparing for a banquet instead of making arrangements for a famine.

Indeed we may be perfectly certain that the peculiar machinery which enables the sun to continue shining must be something which brings up with great promptitude to the surface new particles of hot matter from within, while it carries down with equal promptitude those that have already performed their light-

giving office.

The sun is required to fire off without intermission a vast number of light- and heat-shots into space. And the battalions of particles that have done their work must quickly step behind to reload, while their places must be taken as quickly by a fresh and unexhausted levy of particles from within. Now this recruiting process, which must exist, can surely be nothing else than those violent up-and-down atmospheric currents which observation records. rents which observation reveals to us on the surface of our luminary, and we are thus entitled, as a matter of speculation, to infer that our earth will probably receive peculiarly large supplies of sunlight on those occasions when there is most manifest disturbance on the surface of the sun. In fact we may regard the sun as a species of heat-engine. The ordinary conception of such an engine is that of something provided with cylinders, pistons, valves, wheels, and other mechanical appliances, the furnace and the boiler being kept generally out of sight; but the physical conception is something very different from this. A heat-engine, according to the physicist, is a machine having two temperatures: one being that of the source of heat, and the other that of the refrigerator; and it produces work while heat is carried from the higher to the lower temperature—from the source to the refrigerator, and not only so, but the faster the heat is carried the more work does it produce.

Here the object or end is to produce work, and the means employed is the carriage of heat. But if we regard the sun as an engine we may with propriety reverse this relation between means and end, and look upon the carriage of heat and light to the surface as the end aimed at, and the powerful surface-commotion as the means by which this end is accomplished.

I am by no means satisfied that we can fully explain why the currents on the sun's surface should be so very violent as observation proclaims them to be, but yet it is easy to see that the conditions there present are such as to favour the development of convection-currents of enormous power. Let us agree for a moment to study an ordinary furnace fire. We have here in the first place a carriage of hot air up the chimney which ultimately mixes with the cold air outside, while we have in the second an in-rush along the floor of the room of the cold air which feeds the fire, and which ultimately as hot air goes up the chimney and mixes with the cold air above. Now here we have a true convection-current, an up-rush of hot and an in-rush of cold air, and the more intense this current the more quickly will the fire burn.

It is easy to see in the first place why the hot air ascends the chimney. It does so because it has been expanded by heat, and is therefore specifically lighter than the cold air around it.

But why does a thing specifically lighter than the air ascend? Clearly on account of terrestrial gravitation. If there were no earth it would not a cend at all, and if the earth were less massive than it is it would not ascend so fast as it now does. Clearly then the draught of our chimneys depends upon the mass of the earth.

Again, the draught will depend upon the intensity of the fire, and also upon its size and that of the chimney, for it is obvious that an exceedingly small fire and short chimney would not draw well even though the temperature of the fire should be very

high.
We thus perceive that the intensity of convection-currents depends-

1. On the temperature of the source of heat as compared to that of the cold parts of the arrangement.

2. On the force of gravity.

3. On the scale of the arrangement.

4. We may add that for strong currents it is necessary to have some substance, such as air, that expands greatly under an increase of temperature.

And furthermore such currents are still more augmented in violence by the presence of a condensable substance in the atmosphere, and are thereby rendered abrupt, and, to some extent, incalculable, in their operations, inasmuch as a small cause may produce a very great effect.

Now we have all these elements of power together on the sun's surface. For in the first place the intensity of the sun's heat is very great as compared with the cold of surrounding space. Secondly, solar gravity is very great, being about twenty-eight times greater than terrestrial gravity. Thirdly, the scale of the whole arrangement is very great; and lastly, the substance there present, gas and vapour, is one which expands greatly on being heated. On the sun's surface therefore all these causes of convection currents exist in great strength; and if we bear in mind that they must be multiplied together rather than added we shall not fail to perceive how strong must be the effects which they will produce. Notwithstanding all this, it appears to me that we have more to learn with respect to the causes which produce the extraordinary violence of solar currents.

Although the series of sun pictures made by Schwabe is the first having pretensions to accuracy, yet Prof. Rudolph Wolf has endeavoured to render observations of sun-spots made at different times and by different observers comparable with each other, and has thus formed a list exhibiting approximately the relative number of sun-spots for each year. This list extends back into the seventeenth century, and is in many respects of much value.

By this means Prof. Wolf has shown that the eleven-yearly

period runs through all the recorded observations of sun-spots since the telescope came to be used. And furthermore it appears that these eleven-yearly oscillations are not always of the same magnitude; sometimes they are large, and sometimes small. They were probably small about the middle of last century, becoming large towards the end of it; they were again small about the early part of the present century. They have recently been large, and we may suspect that in future there will again be

a falling off.

Besides exhibiting this complicated periodicity, sun-spots have many other characteristics, the most prominent of which I will now bring before you. Of these the most peculiar is a proper motion of their own. If there were no sun-spots it would be very difficult to determine the elements of the sun's rotation. Accordingly sun-spots have been used for this purpose ever since the telescope was invented. They are carried by the solar rotation from east to west across the visible disk of the sun in about thirteen days, and hence we may conclude that the sun, roughly speaking, rotates round its axis in twice thirteen, or twenty-six days. But Carrington found that spots move fastest when nearest the solar equator, and slowest when nearest the solar poles; and in consequence of this proper motion of spots there is an uncertainty as to the exact period of solar rotation. Another point of interest is the distribution of spots over the solar surface. There are never any at or near the sun's poles, the zone in which they break out having its limits about 30° on each side of the equator. It might be expected from this that we should have a maximum of spots close to the equator, but such is not the case. There are very few at the equator, the maximum number corresponding to a solar latitude of about 15° north or south. We must not however conclude that spots invariably exhibit a preference for this latitude, for Carrington has shown that on certain occasions they appear by preference to seek a higher latitude, widening out on each side of the solar equator simultaneously, while at other times they prefer a lower latitude, coming together towards the equator simultaneously on each side.

Dr. Smysloff of the Wilna Observatory has likewise observed a sort of hemispherical see-saw in the behaviour of spots. Sometimes they prefer the northern hemisphere of the sun-at other times the southern; but this observer is inclined to think that if we pursue our researches for a length of time sufficiently great we shall find an equal amount of spots in each hemisphere.

I have thus endeavoured to bring before you the fact that sun-spots exhibit curiously complicated laws of a roughly periodical nature. Two questions arise from this discussion: the one is of a theoretical nature, and has reference to the possible causes of this behaviour; while the other is of great practical as well as of theoretical interest, and has reference to the effect which these strange solar phenomena produce upon the mag netism and meteorology of the earth and upon the general wellbeing of the human race.

To be continued.

## PROF. ALLMAN ON THE DEVELOPMENT OF THE CTENOPHORA

N accordance with his usual practice of making his anniversary address at the Linnean Society an exposition of recent progress in certain departments of zoological research, the President on this occasion (24th May, 1881) selected as his subject the advances which, during late years, had been made in our know-ledge of the development of the Ctenophora.

He referred especially to the beautiful researches of Alexander Agassiz, and to those of Fol, Kowalewsky, and most recently of Chun. He pointed out the phenomenon to which he was the first to call attention, that immediately after the earliest stages of the egg cleavage a remarkable peculiarity shows itself, in the fact that the continued cleavage is no longer uniform, but takes place much more energetically in certain cleavage spheres than in others, whereby the former are broken up into a multitude of small cells, which gradually envelop the latter, thus giving us at this early period of embryonic development the foundation of the two germinal leaflets, ectoderm and endoderm. He showed, how the body thus formed becomes excavated by an internal cavity, which soon communicates by an orifice with the exterior, thus presenting, as shown especially by the researches of Chun, the condition of a gastrula; how the gastrula-mouth becomes afterwards closed by the continued extension over it of the ectoderm; how a new orifice, the permanent Ctenophoremouth, makes its appearance at the opposite hole, the ectoderm

here becoming invaginated, so as to form the permanent stomach which opens into the central cavity, which becomes the "funnel from which spring all the vessels which are destined to distribute the nutritive fluid through the body; how, in the spot formerly occupied by the gastrula-mouth, certain cells of the ectoderm become differentiated, so as to form the rudimental nervous system; and how the great vascular trunks are formed by the differentiation of portions of the endoderm, into which offsets extend from the central cavity.

Prof. Allman further referred to the facts connected with the metamorphoses which the larvæ of the Ctenophora undergo between the moment of leaving the egg and the attainment of the mature form-facts for which we are mainly indebted to the researches of Alexander Agassiz and of Chun. He showed how the lobed section of the Ctenophora, as proved by the investigations of A. Agassiz on *Bolina*, and by those of Chun on *Eucharis*, are at first quite destitute of the "lobes" which constitute so characteristic a feature in the adult; and how the young Ctenophore has at this time all the characters of the more simply constructed Cydipidæ, Eucharis being also compressed like a Mertensia in the direction of the stomach axis, while in the adult the compression of the body is at right angles to this; how the lobes afterwards grow out laterally from the oral side of the body; how the meridional vessels at first ending in blind extremities extend themselves into the rudimental lobes, and there form the anastomoses and rich convolutions which become so striking in the adult, the stomach vessels finally entering into the anastomoses.

He also referred to Chun's remarkable discovery of the sexually-mature condition of the very early larva of Eucharis, from which was reared a young brood which returned to the

larvæ form from which it originated.

Chun's observations on the metamorphoses of the Venus's firdle (Cestum Veneris) were also dwelt on. It was shown how the young cestum had a nearly globular form, and possessed all the essential features of the Cydipidæ, so that notwithstanding the extremely aberrant characters of the adult the young may be taken as affording a type of the gastro-vascular system, with the distribution of the vessels in the Ctenophora generally. The gradual extension of the Cydippe-like larva in the direction of the funnel-plane changes it into the long, flattened, band-like form of the adult, and brings about (with modifications in the number and direction of the swimming-plates, and the substitution of new tentacles to replace those of the larva which had disappeared) the singularly aberrant course of the vessels characteristic of the mature Venus's girdle.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE .- Mr. J. W. Clark is to be re-appointed Superintendent of the Museums of Comparative Anatomy and Zoology for two years, at the end of which time the Council of the Senate appear to anticipate that some fresh arrangements as to this office

Mr. W. Hillhouse, Assistant Curator of the Herbarium, will give a course of lectures on Morphology and Systematic Botany during July and August, suited to candidates for the Natural Sciences Tripos. In connection with the course there will be practical work in the Gardens and Botanical Laboratory; and a botanical excursion will be made, weather permitting, on

Wednesday in each week.

DUBLIN.-The Professors of the Medical School in Trinity College have, at the suggestion and with the sanction of the Rev. Dr. Haughton, the senior lecturer of the College, introduced into their summer courses of lectures, to a very large extent, practical instruction, instead of the time-honoured and now somewhat antiquated series of prelections. These summer courses chiefly consist of Chemistry, Histology, Botany, Comparative Anatomy, and Operative Surgery. In the Chemistry, instead of listening as formerly to an hour's lecture three times each week, the students work in the laboratory under the superintendence of Prof. Emerson Reynolds, F.R.S., for two hours every alternate day, and on one day in each week attend a demonstration by the Professor on the analysis of water, air, and articles of food. In the Histology Prof. Purser gives a lecture on one day in each week, at the close of which illustrative preparations are shown in the laboratory. On the other days the students are engaged on practical work in the new physiological laboratory, where, as in the chemi-